DISCUSSION

EARTHING ELECTRICAL SYSTEMS TO WATER PIPES[1]

MR. S. W. STRATTON:[2] The Bureau of Standards has had called to its attention the discussion in the March, 1916, issue of the JOURNAL of your Association, on the paper by Mr. McCollum and Mr. Peters of this bureau entitled "Earthing Electrical Systems to Water Pipes". Some have thought that this discussion, partly because of its incompleteness, might give rise to some unfortunate and unwarranted apprehensions on the part of owners of water meters and might also possibly leave some misapprehension of the bureau's position as to the desirability of grounding telephone protectors to water pipes.

In order that the position of the bureau may be correctly stated, with regard to such ground connections, and in order to correct if possible any misapprehensions which may have arisen on this point, the bureau would be glad to have this present statement given publicity in your JOURNAL.

Referring to copy of the National Electrical Safety Code with which the paper on "Earthing" was largely concerned, under rule 393 (a) (2) may be noted the following rule covering the ground connection of arresters and signal systems: "The ground connection shall be made to a cold-water pipe connected to the street mains and any service, where this is available." Neither experience nor theoretical considerations show any appreciable chance of damage to the water piping system because of such connections. The thoughtful consideration of the above mentioned discussion should indicate that the possibility of the heating of meters mentioned in that discussion as a possible disadvantage of permitting the grounding of arresters on water service pipes, is an exceedingly remote one, especially because of the small possible current flow to earth through

[1] A paper read at a meeting of the Central States Section of the American Water Works Association, and printed in the March, 1916, JOURNAL, Vol. 3, No. 1, at pages 201–219. Answering discussion by Mr. Joe C. Beardsley, page 222.

[2] Director Bureau of Standards, Department of Commerce.

telephone arrester ground wires. In case of accidental contact between a telephone wire and a railway trolley or other high voltage wire, the current which could pass through the arrester is limited by fuses to about 7 amperes and the possibility of this causing any appreciable heating in even the smallest service pipes and their connections is entirely negligible.

To show how small the possibility of trouble is, it may be stated that the bureau also strongly recommends the grounding of low voltage alternating current light and power circuits entering buildings to the water service pipe.

The fuses limiting current in ground wires in this case may be as large as 50 or 100 amperes or in certain cases even greater, but even here 100 amperes in a single service pipe would rarely be encountered because multiple grounds are recommended and they would correspondingly reduce the current through any single ground, the total being limited by the fuses as hereinbefore stated. A cross between a high voltage circuit and a low voltage circuit is, of course, very infrequent, but in the infrequent case where the current does flow from such cause, it should be considered what the amount of heating might be in order to demonstrate the improbability of even 100 amperes injuring the smallest service pipe, for instance a $\frac{3}{4}$-inch wrought iron service.

The resistance of a $\frac{3}{4}$-inch wrought iron pipe weighing 1.11 pounds per foot of length is approximately 0.0002 ohm per foot. With 100 amperes flowing the rate of liberation of heat per foot of pipe would be $(100)^2 \times 0.0002 = 2$ watts, or 1720 gram calories per hour. The volume of water per foot of pipe is about 98 cc. Enough heat would be liberated in one hour, therefore, to raise the temperature of the water $1720/98 = 18°$C. To raise the temperature from 20°C. (68° F.) to 60°C. (140° F.), the temperature said to be necessary to injure the hard rubber parts of water meters, would require a current flow of 100 amperes for a little more than two hours. This however, makes no allowance for radiation of heat nor for circulation of water. If these were taken into account, the current required to raise the temperature of the water to 60°C. (140° F.) and maintain it would be a great deal more than 100 amperes. Only in extreme cases, therefore, is there any possibility of injury to water meters from heating of water in service pipes through grounding secondaries to them.

Either with low voltage secondary circuits or with telephone circuits, the duty devolves upon both the water utility and the wire-owning utility of protecting persons and property, and the existence of either by itself in a building is less dangerous than where both are present. Where both are present the prevention of a dangerous voltage between them is essential and no so-called ground connection which can possibly be made on a telephone or other low voltage circuit in any other manner can be compared in effectiveness to that made to the water piping. It is the recommendation of the bureau that grounding of such circuits be made to water connections in all cases where these are available, and either outside the meter or with bond connection around the meter so as to maintain the integrity of the connection in case of work on the meter or its removal. Careful investigation has failed to show any bad experience from such connections warranting either utility in failing to permit the instalment of this desirable protective measure.